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COMMUNICATION

GRASSES OF KUNDADRI HILLS IN THE WESTERN GHATS OF KARNATAKA, INDIA

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Grasses of Kundadri Hills in the Western Ghats of Karnataka, India

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Abstract: The present communication provides a checklist of grass flora in Kundadri Hill of central Western Ghats, Karnataka. During the exploration, a total of 78 species belonging to two sub-families, 12 tribes, and 43 genera of Poaceae have been documented.

Keywords: Checklist, diversity, plant taxonomy, Poaceae.

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Author details: HANCHALI UDAYASHANKAR ABHIJIT is DST Inspire awardee and he has very much Interest in Plant taxonomy and diversity assessment. Presently working on diversity and distribution of grasses in the central Western Ghats of Karnataka, India and he was document the three additional grasses to the flora of Karnataka. YELUGERE LINGANAIAK KRISHNAMURTHY is Professor in Applied Botany and he has expert in Plant Biodiversity - survey, documentation and conservation and fungal endophytes - Enhancement of plant growth by incorporation of beneficial fungi and fungal metabolite profiling, Exploration and characterization of lichens. Presently four of his students working on plant systematics.

Author contribution: HUA - carried out the field work, data collection, identification, photography, herbarium preparation, data interpretation, manuscript writing. YLK - carried out the field work, guided for data interpretation and manuscript writing.

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INTRODUCTION

Grasses are morphologically complex and diverse angiosperms and cover one-fifth of the earth's land surface (Shantz 1954). Twenty-four percent of the earth's vegetation is comprised of Grass; they grow in both tropical and temperate regions (Jain 1986). Globally, grasses are represented by 10,550 species belonging to 715 genera (Pathak 2013) whereas, in India 1,200 species belonging to 268 genera are documented (Karthikeyan et al. 1989; Moulik 1997). About 430 grass species are endemic to India, among them Indian peninsular region shows 55% endemism (Jain 1986).

India is one among the 17 mega biodiversity nations with 5,000 endemic flora (Nayar 1996). In India, the Western Ghats is one of the hot spots and the second most speciose center for endemism comprising 1,500 endemic flora (Nayar 1980). The Western Ghats is a long mountain range running parallel to the western coast of India. It consists of dense evergreen forests, grasslands, streams, and other wetlands. The region receives heavy precipitation from southwest monsoon and has good edaphic factors giving it a dense plant life (Gadgil 1996). Grass flora has been extensively studied in the northern and southern Western Ghats (Sreekumar & Nair 1991; Kabeer & Nair 2009; Potdar et al. 2012). The central Western Ghats, however, remains largely understudied. Therefore, in the present work, we explored the grass

diversity in Kundadri Hill, a hillock in central Western Ghats of Karnataka that records the highest rainfall in peninsular India (Manjunatha 2015).

MATERIALS AND METHODS

Study area

The Kundadri Hill (13.553–13.564 °N and 75.156–75.177 °E) is a monolith (Figure 1). It consists of tropical evergreen forest and patches of shola grasslands. Hill top having 17th century Jain temple of 23rd thirthankara Parshwanath and two ponds that hold water throughout the year. The Hill is located amidst the rain forests of central Western Ghats. It receives 7,620mm average annual rainfall and the average annual temperature is 23.5°C (Manjunatha et al. 2015). This area provides both rocky as well as soil substrates. The rock and its crevices act as a micro habitat for many annual specialized endemic grass communities (Porembski 2000).

Data collection

Opportunistic sampling method was used for the collection of grasses. The survey was conducted during August 2017–August 2019. The habitats for sampling was classified according to Bhat & Nagendran (2001) and Kabeer & Nair (2009). Our study site consisted of open areas, grasslands, road cuttings, rock crevices,



Figure 1. Study area -- Kundadri Hill.

forest area, moist places, shady places, and stream sides. Specimens were collected and identified using floras and research papers (Bor 1960; Bhat & Nagendran 2001; Potdar et al. 2012). Herbaria was prepared as described by Rao & Sharma (1990). The documented grasses are classified on the basis of Bor classification (1960) Voucher specimens are deposited in the herbarium, department of applied botany, Kuvempu University, Karnataka, India.

RESULT AND DISCUSSION

The floristic assessment of the family Poaceae in different regions of the study area revealed a total of 78 species of 43 genera belonging to 12 tribes and two subfamilies. A detailed checklist of grass species, their subfamilies, tribe and habitat of each species (Table 1) and photographs of the selected species (Images 1–4) are provided. The subfamily Panicoideae shows 47 species of 27 genera and two tribes, of which 26 species belong to tribe Andropogoneae including four varieties and 21 species belong to tribe Paniceae. Genus *Ischaemum* shows maximum number of species (seven). The sub family Pooideae shows 31 Species of 16 genera and 10 tribes, in that six species belong to Arundinellae, 10 Species belong to Eragrostaeae, and three species belong to both Chloridae and Isachneae. Two species in Garnotieae, Babuseae, and Sporoboleae and the tribe Aristidae, Centothecaeae, Oryzeae have one species each. Genus *Arundinella* shows the maximum number of species (five) (Figure 2 & 3). *Apluda mutica* L. and *Indopoa paupercula* (Stapf) Bor., are the two monotypic genera recorded during the study. This indicates the small geographical area of Kundadri Hill having rich grass diversity. Open area, moist area, grasslands and, rock crevices are the common habitats in the study area. We documented 26% from the open area, 19% from grasslands, 18% from rock crevices, 13% from moist wet area, 9% from road cuttings, 8% from moist shady area, and 5% and 2% from forest area and stream side, respectively. According to IUCN Red List status all the documented species come under Not Evaluated (NE) category but regionally 27 species are rare and remaining 51 species are common to the study site (Figure 4). Open area, grasslands and rock crevices are the most suitable habitats for grasses in the study area.

Grass flora of northern Western Ghats and southern Western Ghats are well studied (Sreekumar & Nair 1991; Kabeer & Nair 2009; Potdar et al. 2012). Thomas et al. (2012) worked on Chasmophytic grasses of Vellinagiri Hills located in southern Western Ghats.

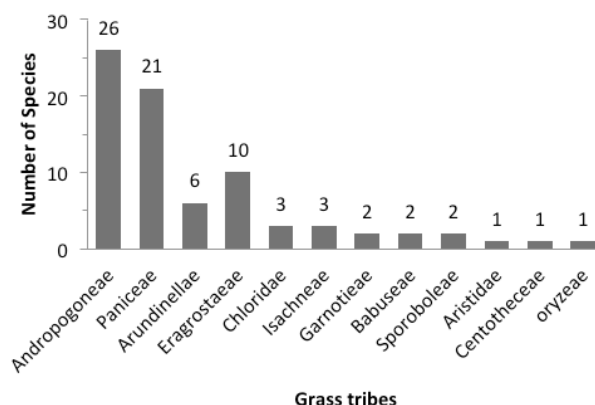


Figure 2. Tribes showing number of species.

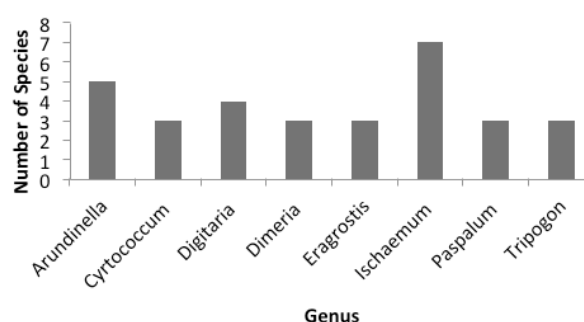


Figure 3. Top eight genera showing maximum number of species.

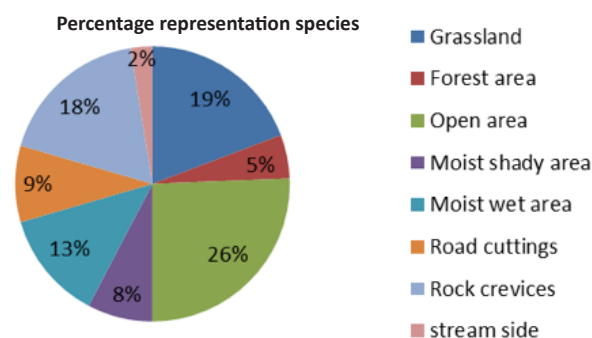


Figure 4. Habitat distribution of documented species.

They documented 30 species of wild chasmophytic grasses belong to 23 genera and dominated by four species of genera *Eragrostis*. Barbhuiya et al. (2013) recorded grasses in Barak Valley of southern Assam around 6,922km² area and provide the checklist of 98 grass species belonging to 49 genera. Region exhibit 32% of grass flora of Assam State. Various authors have explored the flora of central Western Ghats (Saldanha & Nicholson 1976; Yoganarasimhan et al. 1982; Saldanha 1984; Murthy 1990; Ramaswami et al. 2001). Poaceae, however, is underrepresented in these reports except

Table 1. Checklist of documented grasses in Kundadri Hill .

	Botanical name	Subfamily	Tribe	Habitat
1	<i>Acroceras munroanum</i> (Balansa) Henr.	Panicoideae	Paniceae	Moist shades
2	<i>Alloteropsis cimicina</i> (L.) Stapf	Panicoideae	Paniceae	Open area
3	<i>Apluda mutica</i> L.	Panicoideae	Andropogoneae	Road cuttings
4	<i>Aristida setacea</i> Retz.	Pooideae	Aristideae	Open area
6	<i>Arthraxon hispidus</i> (Thunb.) Makino	Panicoideae	Andropogoneae	Rock crevices
5	<i>Arthraxon hispidus</i> var. <i>santapau</i> (Bor) Welzen	Panicoideae	Andropogoneae	Rock crevices
7	<i>Arthraxon lanceolatus</i> (Roxb.) Hochst	Panicoideae	Andropogoneae	Moist shades
8	<i>Arundinella ciliata</i> (Roxb.) Nees ex Miq.	Pooideae	Arundinelleae	Road cuttings
9	<i>Arundinella nepalensis</i> Trin.	Pooideae	Arundinelleae	Stream side
10	<i>Arundinella pumila</i> (Hochst. ex A.Rich.) Steud.	Pooideae	Arundinelleae	Road cuttings
11	<i>Arundinella purpurea</i> Hochst. ex Steud.	Pooideae	Arundinelleae	Grasslands
12	<i>Arundinella tuberculata</i> Munro ex Lisboa	Pooideae	Arundinelleae	Grasslands
13	<i>Bambusa arundinacea</i> (Retz.) Willd.	Pooideae	Bambuseae	Forest area
14	<i>Capillipedium huegelii</i> (Hack.) Stapf	Panicoideae	Andropogoneae	Moist shades
15	<i>Cenotheca lappacea</i> (L.) Desv.	Pooideae	Cenothaceae	Open area
16	<i>Chloris barbata</i> Sw.	Pooideae	Chlorideae	Open area
17	<i>Chrysopogon aciculatus</i> (Retz.) Trin.	Panicoideae	Andropogoneae	Open area
18	<i>Chrysopogon hackeli</i> (Hook.f.) C.E.C.Fisch.	Panicoideae	Andropogoneae	Grasslands
19	<i>Coelachne simpliciuscula</i> (Wight & Arn. Ex Steud.) Munro ex Benth	Pooideae	Isachneae	Moisty area
20	<i>Cymbopogon martinii</i> (Roxb.)	Panicoideae	Andropogoneae	Grasslands
21	<i>Cynodon dactylon</i> L.	Pooideae	Chlorideae	Open area
22	<i>Cynodon radiatus</i> Roth ex Roem. & Schult	Pooideae	Chlorideae	Open area
23	<i>Cyrtococcum deccanense</i> Bor.	Panicoideae	Paniceae	Moist shades
24	<i>Cyrtococcum longipes</i> (Wight & Arn. ex Hook.f.) A.Camus	Panicoideae	Paniceae	Moist shades
25	<i>Cyrtococcum oxyphyllum</i> (Steud.) Stapf	Panicoideae	Paniceae	Moist shades
26	<i>Dactyloctenium aegyptium</i> (L.) Willd.	Pooideae	Eragrosteae	Open area
27	<i>Dichanthium annulatum</i> (Forssk.) Stapf	Panicoideae	Andropogoneae	Open area
28	<i>Digitaria bicornis</i> (Lam.) Roem. & Schult.	Panicoideae	Paniceae	Open area
29	<i>Digitaria ciliaris</i> (Retz.) Koeler	Panicoideae	Paniceae	Open area
30	<i>Digitaria longiflora</i> (Retz.) Pers.	Panicoideae	Paniceae	Grasslands
31	<i>Digitaria radicata</i> (J.Prisl.) Miq.	Panicoideae	Paniceae	Open area
32	<i>Dimeria lawsonii</i> (Hook.f.) C.E.C.Fisch.	Panicoideae	Andropogoneae	Grasslands
35	<i>Dimeria ornithopoda</i> Trin.	Panicoideae	Andropogoneae	Road cuttings
33	<i>Dimeria stapfiana</i> C.E.Hubb. ex Pilger	Panicoideae	Andropogoneae	Rock crevices
34	<i>Eleusine indica</i> (L.) Gaertn.	Pooideae	Eragrosteae	Open area
36	<i>Elytrophorus spicatus</i> (Willd.) A. Camus	Pooideae	Eragrosteae	Open area
37	<i>Eragrostis atrovirens</i> (Desf.) Trin. ex Steud.	Pooideae	Eragrosteae	Moisty area
38	<i>Eragrostis japonica</i> (Thunb.) Trin.	Pooideae	Eragrosteae	Open area
39	<i>Eragrostis unioides</i> (Retz.) Nees ex Steud.	Pooideae	Eragrosteae	Open area
40	<i>Eulalia trispicata</i> (Schult.) Henrard	Panicoideae	Andropogoneae	Grasslands
41	<i>Garnotia arundinacea</i> Hook.f.	Pooideae	Garnotieae	Road cuttings
42	<i>Garnotia tenella</i> (Arn. ex Miq.) Janowski	Pooideae	Garnotieae	Rock crevices
43	<i>Glyphochloa forficulata</i> (C.E.C.Fisch.) Clayton	Panicoideae	Andropogoneae	Rock crevices
44	<i>Glyphochloa mysorensis</i> (S.K.Jain & Hemadri) Clayton	Panicoideae	Andropogoneae	Rock crevices

	Botanical name	Subfamily	Tribe	Habitat
45	<i>Heteropogon contortus</i> (L.) P.Beauv. ex Roem. & Schult.	Panicoideae	Andropogoneae	Grasslands
46	<i>Imperata cylindrica</i> (L.) Raeusch. *	Panicoideae	Andropogoneae	Open area
47	<i>Indopoa paupercula</i> (Stapf) Bor	Pooideae	Eragrosteae	Rock crevices
48	<i>Isachne globosa</i> (Thunb.) Kuntze	Pooideae	Isachneae	Moisty area
49	<i>Isachne gracilis</i> C.E.Hubb.	Pooideae	Isachneae	Moisty area
50	<i>Ischaemum commutatum</i> Hack.	Panicoideae	Andropogoneae	Grasslands
51	<i>Ischaemum indicum</i> (Houtt.) Merr.	Panicoideae	Andropogoneae	Grasslands
52	<i>Ischaemum rugosum</i> Salisb.	Panicoideae	Andropogoneae	Moisty area
53	<i>Ischaemum semisagittatum</i> Roxb.	Panicoideae	Andropogoneae	Road cuttings
54	<i>Ischaemum timorensis</i> Kunth	Panicoideae	Andropogoneae	Grasslands
55	<i>Ischaemum tumidum</i> Stapf ex Bor	Panicoideae	Andropogoneae	Grasslands
56	<i>Ischaemum zeylanicum</i> Bor.	Panicoideae	Andropogoneae	Rock crevices
57	<i>Jansenella griffithiana</i> (Mull. Stuttg.) Bor	Pooideae	Arundinelleae	Road cuttings
58	<i>Leersia hexandra</i> Sw.	Pooideae	Oryzeae	Moisty area
59	<i>Ochlandra scriptoria</i> (Dennst.) C.E.C.Fisch	Pooideae	Bambuseae	Forest area
60	<i>Oplismenus compositus</i> (L.) P.Beauv.	Panicoideae	Paniceae	Forest area
62	<i>Panicum curviflorum</i> Hornem.	Panicoideae	Paniceae	Moisty area
63	<i>Panicum repens</i> L.	Panicoideae	Paniceae	Moisty area
64	<i>Paspalum canarae</i> var. <i>canarae</i>	Panicoideae	Paniceae	Rock crevices
65	<i>Paspalum canarae</i> var. <i>fimbriatum</i> (Bor) Veldkamp	Panicoideae	Paniceae	Rock crevices
66	<i>Paspalum conjugatum</i> P.J.Bergius	Panicoideae	Paniceae	Open area
67	<i>Paspalum scrobiculatum</i> L.	Panicoideae	Paniceae	Moisty area
68	<i>Pennisetum hohenackeri</i> Hochst. ex Steud	Panicoideae	Paniceae	Moisty area
69	<i>Pennisetum purpureum</i> Schumach. *	Panicoideae	Paniceae	Open area
61	<i>Pseudechinolaena polystachya</i> (Humb., Bonpl. & Kunth) Stapf	Panicoideae	Paniceae	Forest area
70	<i>Sacciolepis indica</i> (L.) Chase	Panicoideae	Paniceae	Moisty area
71	<i>Setaria pumila</i> (Poir.) Roem & Schult.	Panicoideae	Paniceae	Grasslands
72	<i>Sporobolus fertilis</i> (Steud.) Clayton	Pooideae	Sporoboleae	Stream side
73	<i>Sporobolus piliferus</i> (Trin.) Kunth	Pooideae	Sporoboleae	Open area
74	<i>Themida tremula</i> (Nees ex Steud.) Hack	Panicoideae	Andropogoneae	Grasslands
75	<i>Themida triandra</i> Forssk.	Panicoideae	Andropogoneae	Grasslands
77	<i>Tripogon bromoides</i> Roem. & Schult.	Pooideae	Eragrosteae	Rock crevices
76	<i>Tripogon capillatus</i> Jaub. & Spach	Pooideae	Eragrosteae	Rock crevices
78	<i>Tripogon lisboae</i> Stapf	Pooideae	Eragrosteae	Rock crevices

* non-native species.

for Bhat & Nagendran (2001), who have explored grasses and sedges in Dakshina Kannada and Udupi districts which act as a first grass flora of central Western Ghats. We recorded 78 species of grasses in our study site which is just around 155ha. This represents 6.5% of grass species recorded in India. This indicates the richness of grass species in the region. Much of the documented species are recorded in habitats like rock crevices and grasslands which are prone to change in land (Figure 4). Habitat disturbance is known to alter grassland species

composition (Joy 1992). Various disturbance factors like livestock grazing, ecotourism, and development affect Kundadri Hills. Similarly, threats like urbanization, encroachment, agricultural intensification, resource exploitation are plaguing the Western Ghats region (Gunawardene et al. 2007). Therefore, we stress the importance of conservation of these species and the habitat.



Image 1. A—*Arundinella ciliata* | B—*Arundinella pumila* | C—*Arundinella purpurea* | D—*Dactyloctenium aegyptium* | E—*Digitaria Radicosa* | F—*Dimeria stapfiana*.



Image 2. A—*Chrysopogon aciculatus* | B—*Garnotia tenella* | C—*Eulalia trispicata* | D—*Themida tremula* | E—*Themida triandra* | F—*Leersia hexandra*.



Image 3. A—*Setaria pumila* | B—*Tripogon lisboae* | C—*Paspalum canarae* var. *canarae* | D—*Paspalum scrobiculatum* | E—*Jansenella griffithiana* | F—*Sacciolepis indica*.



Image 4. A—*Ischaemum indicum* | B—*Eleusine indica*. | C—*Indopoa paupercula* | D—*Glyphochloa mysorensis* | E—*Heteropogon contortus* | F—*Pennisetum hohenackeri*.



Image 5. Spikelets diversity: A—*Apluda mutica* | B—*Arthraxon hispidus* var. *santapau* | C—*Dichanthium annulatum* | D—*Dimeria lawsonii* | E—*Glyphochloa forficulata* & *G. mysorensis* | F—*Ischaemum rugosum*.



Image 6. A—Kundadri Hill | B—adjacent hill of Kundadri | C—Jain temple at hill top | D & E—different habitats of grasses | F—collection of grasses.

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